This application is a continuation of allowed U.S. Patent Application serial number 10/291,884, which is a divisional application of U.S. Patent Application serial number 09/448,368, filed November 23, 1999, which claims the benefit of U.S. Provisional Patent Application serial number 60/109,716 filed November 24.1998.

Please replace the paragraph beginning at page 4, line 14 with the following:

Figure 2 is a top, rear, perspective view of marine outboard combustion engine [100]101. In Figure 2, ECU 100 is mounted adjacent capacitor 104 and above and behind flywheel cover 103, although, as stated above, this position could be anywhere that is desired. ECU 100 has two electrical harness connectors, a forward connector 116, and a rear connector 118. Engine 101 also includes a main power relay 120, a water temperature switch 122 and a water temperature sensor 126. A vapor separator vent hose 124 leads to a vapor separator (not shown). A water hose 128 from the vapor separator wraps around ECU 100. Several fuel hoses 130 are connected to a fuel junction block 132. Engine 100 has a throttle position sensor 108 used to determine the actual throttle position.

Please replace the paragraph beginning at page 5, line 8 with the following:

In addition to sensors (described below) located outside of ECU 100, any desired number of sensors [139](not shown in Figure 3) are located inside ECU 100. Sensors [139]can be conventional sensors. Sensors [139]can, by way of example, be sensors for barometric pressure, control unit temperature, alternator voltage (26 volts), battery voltage (12 volts), and ROM verification.

Please replace the paragraph beginning at page 7, line 4 with the following:

Figure 7 is an external view of forward connector 116 of ECU 100[and includes a table showing pin number, circuit description and wire coloring code for connector 116]. Coding of the 24 pins 151 labeled 1 through 24 in Figure 7 in connector 116 is merely an exemplary embodiment and not the only coding which may be used. Pins 151 could be smaller than shown

and could be electrically spaced to prevent cross signals and cross currents. Connector 116 has a plurality of pins positioned in two parallel arrays 152, 154 of 12 pins each, commonly located within a rectangular wall shield 156, but other arrangements could be utilized. For example, pins 151 and shield 156 could be located on the wiring and corresponding sockets located in ECU 100.

Please replace the paragraph beginning at page 7, line 14 with the following:

Figure 8 is an external view of rear connector 118 of ECU 100.[Fig 8 includes a table showing pin number, circuit description and wire coloring code for connector 118.] It will be appreciated that coding of the 24 pins 157 labeled 1 through 24 in Figure 8 in connector 118 is merely a preferred embodiment and not the only coding which may be used. Pins 157 could be smaller than shown and could be electrically spaced to prevent cross signals and cross currents. Further, while connector 118 is shown as being a plurality of pins 157 positioned in two parallel arrays 158, 160 of 12 pins each, commonly located within a rectangular wall shield 162, other arrangements could be utilized. For example, pins 157 and shield 162 could be located on the wiring and corresponding sockets located in ECU 100.

Please replace the paragraph beginning at page 7, line 24 with the following:

Figure 9 is a block diagram illustrating ECU 100. Figure 9 is laid out in logic sequence showing portions that are contained within ECU 100 and the portions that are outside of ECU 100. Specifically, sensors such as water temperature sensor 126 and throttle position sensor 110 and various other sensors in powerhead 102 and elsewhere in engine 101, collectively referred to as [box]<u>sensors</u> 164 are outside of ECU 100. The signals from sensors 164 are connected through the electrical wiring harness connectors to input circuits 168 within the ECU 100. In addition to sensors 164 located outside ECU 100 are various sensors located inside ECU 100, which are collectively numbered 166[, and which were previously exemplified by sensors 139]. Sensors 166 are also connected to input circuits 168. Input circuits 168 perform certain receiving, conversion and other functions with respect to those sensors and generate output data

that is fed to control circuits 170. Circuits 170 analyze output data from input circuits 168 and generate control signals to various circuits within ECU 100. Some of these various circuits which receive control signals from control circuits 170 are [field]fuel injector output drive circuits 172, oil pump output drive circuits 174 and ignition circuits 178. Of particular note is that ignition circuits 178 are located within ECU 100, which is in contrast to prior art. This is allowed, in part, by water-cooled nature of ECU 100, such as is exemplified by presence of water passage 134 in heat transfer adjacency to ECU 100. Circuits 178 have ability to determine whether or not ignition coils have fired, since circuits 178 are within ECU 100 and are thus microprocessor based. This is in contrast to prior art ECUs which placed the ignition circuit outside of ECU 100 and thus did not allow such verification of firing. Fuel injector output drive circuits 172 receive control signals from control circuits 170 and transmit operational signals to fuel injectors 176. Oil pump output drive circuits receive control signals from control circuits 170 and transmit operational signals to oil pump 180. Ignition circuits 178, similarly, receive control signals [form]from control circuits 170 and selectively allow ignition power to ignition coils 182, which, in turn, provide high voltage current at precise intervals to spark plugs 184 to generate ignition sparks which power engine 101.

Please replace the paragraph beginning at page 8, line 25 with the following:

Figure 10 is a block diagram illustrating a power distribution panel 186 for ECU 100[and includes a table listing electrical circuitry wiring of panel 186]. Panel 186 includes various relays, uses and color-coded wiring. Many of these are connections to parts of engine 101 other than ECU 100[and will thus be mentioned only by noting that they are listed in the table in Figure 10]. It will be understood that Figure 10 is provided primarily for purposes of background information and enablement and not as any kind of limitation. Panel 186 can include any desired number and type of power connections or components. Panel 186 includes a 12 volt supply [188]to ECU 100 through a fuse[192], a switched 12 volt connection to ECU 100, a 26 volt supply[194] to ECU 100, an ECU connection[1008] to the fuel pump relay, and any other signal which is needed to power engine 101 under the direction of ECU 100.

Please replace the paragraph beginning at page 9, line 7 with the following:

Figure 11 is a block diagram of sensor and circuit switches included within external portion 196 of the sensing and switching system for engine 101 with which ECU 100. Figure 11 shows switches and sensors that are external to ECU 100 of Figure 3-6. Figure 11 shows sensors 164 that are connected through front electrical wiring harness connector 116 to input circuits 168 in ECU 100. It is preferable to use a separate wiring harness connector for the sensors/switches and the command controls/power signals. Among the sensors and switches in Figure 11 are water temperature sensor 198, water temperature switch 200, shift interrupt switch 202, crankshaft position sensor 106, rectifier/regulator 204, capacitor 104, power distributions panel 186, diagnostic connector 206, 208, throttle position sensor [134]108, air temperature sensor 210 and an oil pressure switch 212. The color coding of wiring used to interconnect these circuits, and ECU 100 are listed in a table below Figure 11 for correspondence with coding shown in Figure 7 and Figure 8. As noted previously, there is no particular magic to color-coding used, except that it is intended to make repair jobs easier for repairmen. In this regard, special attention is directed to diagnostic connector 206, 208 that connects to ECU 100 and thereby to start a diagnostic routine within ECU 100 and also connects to a diagnostic unit (not shown) such as might be used by a repairman.[A legend is included with Figure 11 in order to identify various sensors and switches which are shown on Figure 11.]

Please replace the paragraph beginning at page 11, line 1 with the following:

The shift interrupt switch 202, which is used for six-cylinder engines only, is in contact with a shift lever. The switch is normally open. When the button is depressed (by excessive shift loads), the switch is closed and completes a ground circuit. ECU 100 momentarily shuts off fuel and spark to three cylinders (for example, Nos. 2,4,6) to momentarily reduce drive train loads and ease shifting, then automatically restores normal engine operation. The signal threshold can be, for example, 2144 RPM and the shift interrupt function will not work above it. Switch 202 must be released to its normally open position before the interrupt circuit can be

actuated again. ECU 100 provides a voltage signal to the shift interrupt switch; another wire connects the switch to a powerhead ground. If the switch or its circuit fails, ECU 100 will store a service code and turn on the "CHECK ENGINE" light.

Please replace the paragraph beginning at page 11, line 12 with the following:

The throttle position sensor [134]108 is a rotary potentiometer located near flywheel cover 103, and contacts a vertical throttle shaft. Sensor [134]108 receives a voltage signal from ECU 100. As the throttle lever is rotated, ECU 100 receives a return voltage signal through a second wire. This return voltage signal is relative to the position of the throttle shaft. As the throttle opens, voltage increases. As the throttle closes, voltage decreases. A third wire completes the ground circuit back to ECU 100. If sensed values are out of limits, or sensor [134]108 or its circuit fails, ECU 100 will turn on the "CHECK ENGINE" light, store a service code, and automatically reduce engine speed to idle. Once a throttle position circuit fault has been detected by sensor [134]108 and ECU 100, engine 101 will not accelerate above idle speed. To reset, engine 101 must be stopped and the fault corrected.

Please replace the paragraph beginning at page 12, line 21 with the following:

Figure 12 is a block diagram of a portion 214 of an ignition circuit 178[,182,184 of] for powerhead 102 which is external to ECU 100, and specifically[and which connects to internal portion 178 of overall ignition circuit 178, 182, 184] for a four-cylinder engine. Portion 214 includes ignition coils 182 and spark plugs 184[, although coils 182 are shown in more detail in Figure 12]. Portion 214 connects primarily to connector 118, but also includes crankshaft position sensor 106, which is connected to input [circuit]circuits 168 (shown in Figure 9)of ECU 100 through connector 116. The power connections to and from power distribution panel 186 are made through connector 118 to dual ignition coils 216, 218 for the cylinders as shown. Coils 216, 218 lead to spark plugs 220, 222, 224 and 226. [Circuit 178, 182, 184]Portion 214 further includes a key switch 228 to provide security to the starting function of engine 101.

Please replace the paragraph beginning at page 13, line 3 with the following:

Figure 13 is a block diagram of portion 230 of another ignition circuit 178[,182,184 of] for powerhead 102[102] which is external to ECU 100 and which is specifically[connects to internal portion 178] for a six-cylinder engine. It will be understood that portion 230[this ignition circuit 178,182,184] connects primarily to connector 118, but also includes crankshaft position sensor 106, which is connected is to input circuits 168 (shown in Figure 9) through connector 116. The power connections to and from[the] panel 186 are shown to be connected through connector 118 to the ignition coils 232, 234, 236, and 238. Coils 232, 234, 236, and 238 are, in turn, connected to spark plugs 240, 242, 244, 246, 248 and 250. A key switch 252 provides security to the starting function of engine 101.

Please replace the paragraph beginning at page 13, line 12 with the following:

Figure 14 is a block diagram of a fuel injector circuit 176 for a four-cylinder engine, showing connections to fuel injector output drives circuits 172 of ECU 100. [As with the ignition circuit 178,182,184, power]Power for operation of fuel injectors is also provided by power distribution panel 186 through rear electrical wiring harness connector 118. Power is then provided within ECU 100 to fuel injector output drive circuits 172, (shown in Figure 9) and from circuits 172 out of ECU 100 through rear electrical wiring harness connector 118 to four fuel injectors 254, 256, 258 and 260[of circuit 176].

Please replace the paragraph beginning at page 13, line 19 with the following:

Figure 15 is a block diagram of a fuel injector circuit 262 for a six-cylinder engine, showing connections to fuel injector output drives circuits 172. [As with the ignition circuit 178,182,184, power]Power for operation of fuel injectors is provided by power distribution panel 186 through the rear electrical wiring harness connector 118 to fuel injector output drives circuits 172, (shown in Figure 9) and from circuits 172 back through rear electrical wiring harness connector 118 to six fuel injectors 264, 266, 268, 270, 272 and 274.

Please replace the paragraph beginning at page 13, line 26 with the following:

Figure 16 is a left, front, top exterior exploded perspective view of a portion of an outboard engine in partial cutaway to show one exemplary flow pattern for a coolant system 279 for cooling water flow through engine 101 when adapted for use with ECU 100 of Figures 1-3. Cooling water enters lower unit 276 through water intake openings 278 and passes upwardly through lower unit 276 into a mid-section 280 into powerhead 102. This cooling water them circulates within powerhead 102 to cool appropriate components and then exits downwardly through mid-section 280 and out of water vents 282 or out of prop mounting cavity openings 284. This completes the water cooling circuit. The water will be circulated in powerhead 102 in the manner shown below in Figure 17. It will be recognized that although an outboard engine 101 is shown, and inboard or inboard/outboard engine could be substituted for engine 101. It will also be understood that the water may flow [through the]in heat transfer adjacency with a fuel pump in the engine.

Please replace the paragraph beginning at page 14, line 10 with the following:

Figure 17 is a flow diagram of the coolant flow system 286 of engine 101 connected to ECU 100 and the fuel supply connected to the fuel injectors in order to fuel engine 101. System 286 and [the]a fuel supply/fuel return system 288 for a 4-cylinder engine would be similar for a 6-cylinder engine, except there would be additional fuel supply and return lines. In coolant flow system [279 and coolant system]286, water from the environment enters lower unit 276 (shown in Figure 16) via a port adapter [290]and to a water pump 279(shown in Figure 16). From pump 279, water passes through a mid-section 280 (shown in Figure 16) into powerhead 102 to the inlet 291 of a unit 292 through an inlet waterline [294]293. This coolant then flows from unit [296]292 through an outlet [297]294 and then through a coolant supply line [298]296 to the inlet 136 of water passage 134, through water passage 134, out of the outlet 138, and then on through a cooling water drain line 300 and then back to the environment through the lower unit 276. This cools at least a portion of ECU 100.

Please replace the paragraph beginning at page 14, line 22 with the following:

Figure 17 also shows the fuel supply system 288. Fuel enters system 288 through the fuel supply hose [290]302 from a fuel tank [293]304 past a sensor [294]306 and a second fuel line [296]308 to a fuel regulator [298]310. The fuel then passes through the jacket of the unit 292 to a fuel pump [300]312. From the fuel pump [300]312, the fuel passes through a third fuel line [302]314 to a fuel distribution block [304]316, where it is divided into four supplies for four fuel injectors 254, 256, 258 and 260. Any excess fuel from the fuel injectors is returned via fuel return lines [306, 308, 310, 312]318, 320, 322, 324 to a second fuel junction block [314]326. From this second fuel junction block [314]326 the fuel then returns through a return line [316]328 to the fuel regulator [298]310 to repeat the fuel supply cycle. Fuel return line [316]328 is provided with a test point [318]330 for purposes of verifying adequate fuel flow.

Please replace the paragraph beginning at page 15, line 3 with the following:

Figure 18 is a schematic drawing of [the]an overall electric wiring system [186]400 for [the]engine 101 exemplifying how the main engine parts can be electrically connected. Power distribution panel 186 provides power for system [186]400. The sensor circuits lead to connector 116. Ignition [circuit 216 is]circuits 178 are connected to ECU 100 through connector 118. Crankshaft position sensor 106 is part of system [186]400. System 400 further includes fuel[Fuel] injector circuits [176 appear,]and fuel supply tank [293 is seen]304.